7.1 Why we use Machines

I. Machines - a device that makes work easier
  A. Complex Machines vs Simple Machines
    1. Simple Machines do work through one movement
    2. There are six types of simple machines
      → Figure 7-1, p.180

II Advantages of Simple Machines
  A. Machines make work easier by changing force you exert in size, direction, or both
  B. Overcoming gravity and friction
    1. When using a simple machine, you are trying to move something that resits being moved
  C. Applying Force and Doing Work
    1. Two forces are involved when a machine is used to do work
(Fe) ← a. Force applied to the machine = effort force
(Fr) ← b. Force applied by machine to overcome resistance = resitance force

Dec 13-9:33 AM

2. Must consider two kinds of work, work done on the machine and work done by the machine
  a. Work done on the machine = Work input (W_{in})
  b. Work done by the machine = Work output (W_{out})
  c. Equation: $W_{in} = F_e \times d_e$ (displacement of effort force)
    $W_{out} = F_r \times d_r$

3. Ideal Machines – no energy is converted (lost) to heat
  a. Ideal Machine is where $W_{in} = W_{out}$ or
    $F_e \times d_e = F_r \times d_r$

D. Mechanical Advantage – # of times a machine multiplies the effort force
  1. $MA = \frac{\text{resistance force}}{\text{effort force}} = \frac{F_r}{F_e}$
  2. Some machines don't multiply force, they simply change the direction of the effort force

Dec 13-10:32 AM

7.1 Review

Grade: 8th

Subject: Physical Science

Date: 12/13

Dec 13-9:33 AM

1 Find the effort force needed to lift a 2000-N rock, using a jack with a mechanical advantage of 10. Remember, MA = (Fr/Fe). Units for answer is N.

$MA = \frac{Fr}{Fe}$ $10 = \frac{2000}{Fe}$

$Fr = 200$

Dec 13-9:36 AM

2 A carpenter uses a claw hammer to pull a nail from a board. The nail has a resistance of 2500 N. The carpenter applies an effort force of 125 N. What is the mechanical advantage of the hammer?

$F_r = 2500\ N$

$F_e = 125\ N$

$M_a = \frac{F_r}{F_e}$

$M_a = 20.$

Dec 13-9:37 AM

3 The force applied to a machine is called the effort force.

False

True

Dec 13-9:38 AM

4 A simple machine does work with ~~a few movements~~ one movement.

True

False

Dec 13-9:40 AM

5 Suppose you want to use a simple machine to lift a 6,000-N log from a fallen tree. What effort force will you need if your mechanical advantage is 25 (answer in N)?

$$MA = \frac{Fr}{Fe}$$

$$25 = \frac{6{,}000}{Fe}$$

$Fe = 240$

Dec 13-9:41 AM

7.2 The Simple Machines

I. Levers - a point, free to pivot, or turn, about a fixed point

A. Fixed point = fulcrum

1. Part of lever where effort force is applied = effort arm
2. Part of lever that exerts resistance force = resistance arm

B. Finding the Ideal Mechanical Advantage

1. IMA = length of effort arm / length of resistance arm $= \frac{Le}{Lr}$

Dec 17-9:25 AM

C. 3 types of levers

1. 1st class : fulcrum between Le + Lr, multiplies distance
2. 2nd class : Lr between fulcrum and Le, multiplies force
3. 3rd class : Le between fulcrum + Lr, MA is less than 1

II Levers with a human touch

A. Body's structural system contains 1st - 3rd class levers → Figure 7-6 for examples

III Pulling with Pulleys

A. Pulley - grooved wheel with a rope or chain running along the groove

1. Fixed pulley - attached to immovable object
   a. IMA = 1, does not multiply force
2. Movable pulley - attached to a crane, IMA =
   a. multiplies effort force
3. Block - Tackle - combination of movable + pul
   a. IMA = 4, see Figure 7-8 p.191

Dec 17-10:17 AM

IV Wheel and Axle - simple machine consisting of two wheels of different sizes that rotate together

A. Examples: door knob and faucet handle

1. IMA = $\frac{\text{radius of wheel}}{\text{radius of axle}} = \frac{rw}{ra}$

B. Gears are modified wheel-and-axle machines

V Inclined Plane - sloping surface used to raise objects

A. IMA = $\frac{\text{effort distance}}{\text{resistance distance}} = \frac{\text{length of slope}}{\text{height of slope}} = \frac{l}{h}$

VI The Screw

A. Inclined plane wrapped around in a spiral around a post

VII The Wedge - inclined plane with one or two sloping sides

A. Examples: chisels, knives, or blades

Dec 17-10:31 AM

7.2 Review

Grade: 8th

Subject: Physical Science

Date: 12/17

Dec 17-9:05 AM

1 A lever is a bar that is free to turn about a fixed point.

Dec 17-9:20 AM

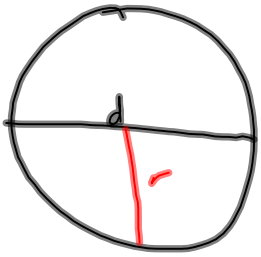
2 The fixed point of a lever is called the ~~wheel-and-axle~~ fulcrum.

True

False

Dec 17-9:21 AM

3 An automobile steering wheel with a diameter of 48 cm is ued to turn the steering column with a radius of 4 cm. What is the IMA of this wheel and axle?



$IMA = \frac{r_{wheel}}{r_{axle}}$

diameter = 48/2 = radius = 24 cm

$\frac{24}{4} = 6 = IMA$

Dec 17-9:23 AM

4 A ramp is an example of a simple machine called a(n) _____.

A screw
B lever

D wheel and axle

C inclined plane

Dec 17-9:24 AM

5 Chisels, knives, and axes are examples of wedges.

Dec 17-9:25 AM

7.3 Mending with Machines: Technology

I. Human body as a Machine

A. Many parts of the human system work like machines

B. Bionics - the science of designing artificial replacements for parts of the human body

1. Artificial replacements = prostheses

C. Human muscles respond to small electrical shocks

1. FNS = Functional Neurotransmitter Stimulation

D. New technology is being developed to link computers to human organs + muscle fibers

Jan 1-1:40 PM

7.4 Using Machines

I. Compound Machines - a combination of two or more simple machines

A. Pedal Power

1. Pedal mechanism is a wheel-and-axle system made up of two wheels attached to the same axle

B. Finding the Mechanical Advantage (MA) of a Bicycle

1. Overall MA of a bicycle is the ratio of the resistance force exerted by a bike on road to effort force by rider on pedals

→ see Figure 7-16 (p. 199)

II Efficiency - measure of how much work put into machine is changed into useful work put out by machine

A. Efficiency = $\frac{W_{out}}{W_{in}} \times 100\% = \frac{F_r \times d_r}{F_e \times d_e} \times 100\%$

III Power - the rate at which work is done

A. Power = $\frac{work}{time}$ or $P = \frac{W}{t}$

1. Power is measured in Watts

a. 1 W = One joule of energy per second

Jan 2-10:34 AM

7.3/7.4 Review

Grade: 8th

Subject: Physical Science

Date: 1/2/12

Jan 1-1:40 PM

1 _____ is the science of designing artificial replacements for parts of the human body.

Jan 1-1:41 PM

2 A(n) _____ is a combination of two or more simple machines.

A compound machine
B mechanical advantage
C ideal mechanical advantage

Jan 1-1:45 PM

3 _____ is a measure of how much of the work put into a machine is changed to useful work put out by the machine.

Jan 1-1:45 PM

4 A power lifter lifts a set of weights that weigh 500 N a distance of 1.0 M in 1 second. How much power does the weightlifter exert (answer in Watts)?

Jan 1-1:47 PM

5 A sofa weighing 1200 N must be placed in a truck bed 1.0 m off the ground. A worker uses a force of 500 N to push the sofa up an inclined plane that has a slope length of 5.0 m. What is the efficiency of the inclined plane (a %)?

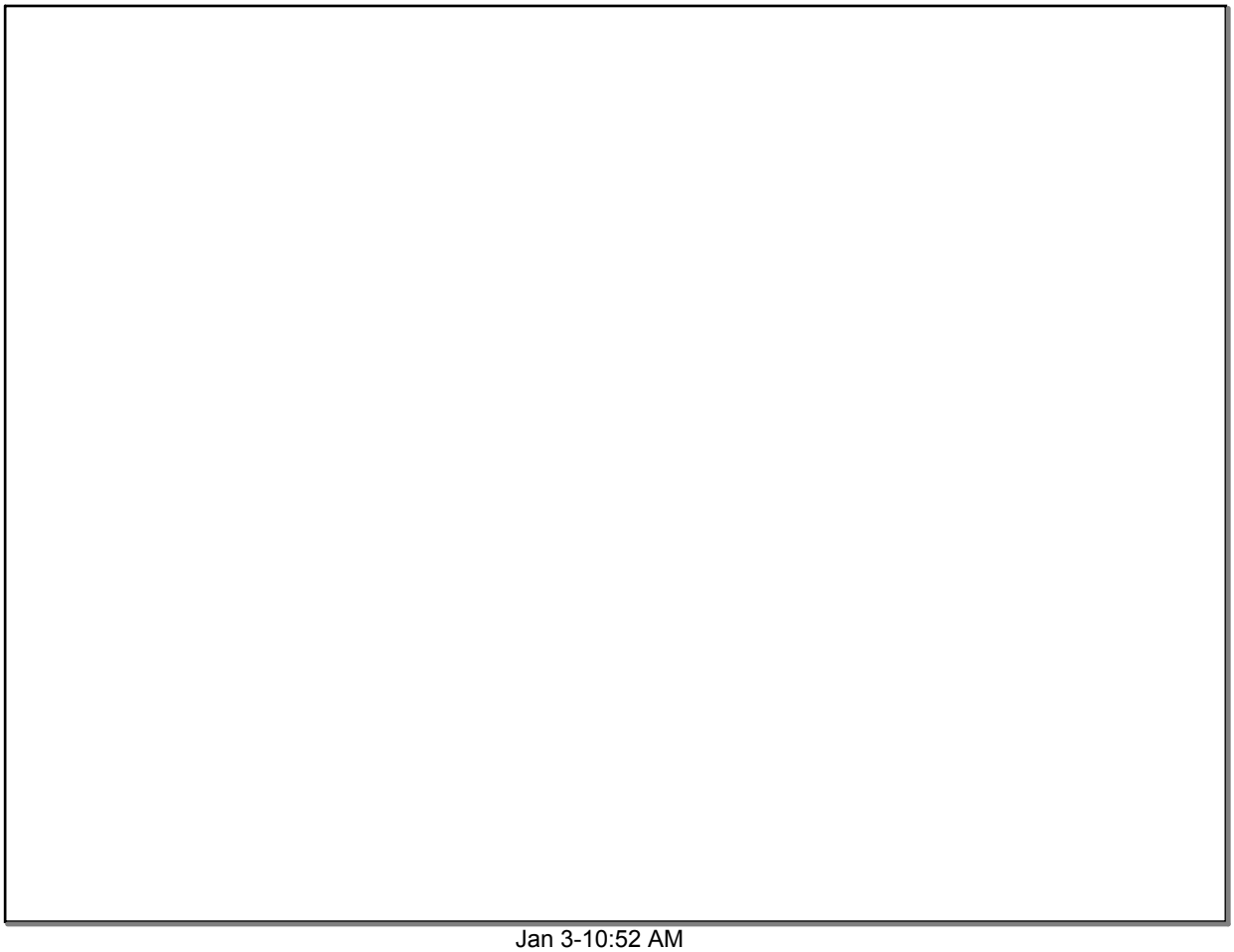
Jan 1-1:52 PM

6 A figure skater lifts his partner who weighs 600 N, 1.2 m in 2.4 s. How much power is required (answer in Watts (W))?

$W = F \cdot d \qquad P = \frac{W}{t}$

$P = \frac{F \cdot d}{t} \qquad \frac{600N \cdot 1.2}{2.4}$

Jan 1-1:54 PM



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